THESIS.

THE USE OF PATENT PILLS AS ABORTIFACIENTS, WITH A SPECIAL REFERENCE TO THE BASOPHILIC GRANULATIONS OF THE ERYTHROCYTES OF THE BLOOD.

W. HARWOOD NUTT,
M.B., Ch.B. Edin.

1905.

From my experience in the Sheffield Royal Hospital, I have reason to believe that the use of patent pills as an abortifacient is a fast growing evil and a social scandal. Any woman can procure "Female corrective Pills" from almost any so-called respectable chemist without running any risk of being asked difficult questions. From the analysis of some of these pills it is shown that she canget sufficient of a powerful drug, not only to remove so-called obstructions, but to produce grave disease of bowels, kidneys, central and peripheral nervous systems, not unfrequently wrecking the health temporarily but permanently and even leading to fatal results as evidenced by several writers. Added to this the desired result is not always secured as there is a wide margin of uncertainty in the action of the drug which always endangers life and sometimes destroys it, at least leaving behind it some temporary enfeeblement of body or mind.

There must be a great demand for what are considered safe patent remedies as evidenced by a black-mailing case tried at the "Old Bailey" (12) before Mr. Justice Hawkins, in which 3 brothers blackmailed 12,000 women in the course of 2 years. They were notified by circular that "a public official was in possession of evidence that the recipient had committed the awful crime of preventing the birth of a child; that legal proceedings

had commenced; and that she would be arrested in a few days unless the sum of two guineas in postal order - not cheques - were sent at once to the public official, to cover his costs." No doubt all these had had dealings with these men; they had either made enquiries or purchased from them or their confederates. Many of these remedies are sold to a too confiding public and expressly stated to be harmless, in fact a good blood tonic and incapable of producing the effects claimed for it.

These are put before the public and sold to bring on delayed menstruation, the veiled meaning of this being perfectly obvious, and it comes as a ray of hope to the over-worked, ill-nourished, child-bearing woman. It opens to her the possibility of escaping from the trials of child-bearing and rearing for which she often has but little strength.

No doubt not a few women have been persuaded to take patent pills for the purpose of procuring abortion and who would never have done so had not vile advertisements and pamphlets been forced before their notice by door to door distribution - as stated by some of my own cases - and by advertisements on the subject, and would certainly never have done so if they had suspected the terrible risk they ran to life and health. In the light of these cases I am convinced that some of the obscure

nervous disorders with attendant anaemia, might be explained such as are seen in the out-door department of any of our large hospitals. Yet on the sale of these abnoxious drugs there is no restriction, for they can be purchased almost anywhere although they expressly state that their function is "to remove irregularities, suppressions and obstructions." These clearly meaning those of the menses. Pregnancy being the most common cause of the cessation of the menstrual flow. Thus women are incited to commit the crime of abortion, ruining their health and usefulness, destroying domestic order and becoming a burden to public charities. This is mostly done without the knowledge of the husband.

This pestilent traffic of abortifacients and female remedies seem to enjoy absolute freedom, flouting a Government stamp in the face of every purchaser, giving it authority and respectability in the eyes of the ignorant.

Some means should be found to suppress the traffic which is a direct incentive to ignorant women to commit crime. At present it constitutes a public danger of no small importance as there is much evidence of the practice of using these pills as abortifacients and that it is widespread.

One means at least to make known the practice and its extent is that every case of lead poisoning and its source should be notified by medical men,

and that the sale of such dangerous drugs should be classified as poisons and sold as such, as frequent deaths have occurrred.

Dr. F. M. Pope of Leicester (13) reports two fatal cases from taking diachylon for abortion.

The following have reported similar cases, also

G. F. Crooke, Birmingham (14)

Bell Taylor, Nottingham (15)

Branson of Nottingham (16)

Ransom of Nottingham (17)

Wrangham of Leicester & Sheffield (18)

Scott of Nottingham (19)

Jacob & Trotman (20) and Layton of Walsall (21)

Dr. Hall (9).

Case 1.

History:- About the beginning of September, 1904, a married woman, age 28, believed that she had a miscarriage. She had not menstruated for two months. Several days before the miscarriage she had become suddenly ill, developing severe pain in her abdomen and chest, was very constipated, had violent headaches, vomited several times, felt sick and tired, followed by complete loss of speech for a week. During the second week of her illness she could only mutter snatches of sentences. She had what her friends believed to be an epilectic fit, losing consciousness and foaming at the mouth followed by uncontrollable screaming fits which came on without warning any time during the day or night. The bowels and bladder were out of her control. She was unable to take food of any description, and lost the sight of her right eye. With the left one she saw things double, also shadows flitting before her.

She had two children and did not want another, so she resorted to Dr. P.....'s and Dr. D ....'s patent female pills. She had taken a number of these before her illness.

Condition on admittance to Hospital:- Patient was unable to answer questions and could only be induced to utter monosyllables. She was very much depressed and low spirited. She thought

that every one was unkind to her and that she was being prosecuted. She dreaded her home and did not want to return to it, refusing to see her husband against whom she had taken a strong dislike. At times she believed that he was dead and no one could convince her of the contrary.

Her appetite was very bad. Her breath was foul. There was no vomiting. All her molars were carious. A well marked blue line was seen along the alveolar margins of her gums. Had severe abdominal pain and obstinate constipation. There was complete loss of control of bladder and bowel. Her nutrition was poor with general wasting of her muscles. Was markedly cachetic with pale mucus membranes. Her shoulders and arms were painful on pressure. Muscular power weak in legs. She could not stand or walk having quite lost her balancing power. Her grip was very much weakened especially of the right hand. There were some jerking movements of the right arm which were spasmodic and arythmical. Tendon reflexes were normal. Had some optic neuritis in both discs which were swollen. A perimeter tracing of her optic fields showed no contraction.

Her mental condition was unstable, at times becoming delirious and noisy.

In the mitral area there was a blowing murmur propagated into the axilla. No albumen in urine. Her pulse was 78 and somewhat irregular in

time and force. Her temperature was normal. Her blood count was as follows:-

Erythrocytes 2.800.000 per cubic millimeter.

Leucocytes 4,000 " " "

Haemoglobin 70 %

Color index 1.25

Basophile granular cells 6 per cent.

There was marked basophilic granulations in the erythrocytes and paleness in their staining power.

Treatment and progress:- The patient was put upon potassium iodide grains X three times a day and magnesium sulphate and fluid diet.

Up to the 7th October she made marked improvement. Her mental condition was clearer, when suddenly, without any apparent cause, she became wildly delirious, screaming loudly and throwing herself about, throwing off the bedclothes and trying to escape from her persecutors, who as she thought were punishing her for things that she had not done. The restraining sheet had to be used, Morphia injected hyperdermacally gr. ¼ at frequent intervals, paraldahyde and chloral-bromide mixtures were quite useless.

In two days' time her acute mania had subsided. She then slowly improved. Her mental condition was very depressed and painful for some time. She was sure that she was going to die and nothing would

save her. Her memory slowly returned. Her delusions regarding her husband varied between love, fear, hatred and impending loss.

Up to the middle of November her sight was markedly affected. She had diplopia, letters all ran together and there were darting lights and colors before her. She could not bear bright light. Gradually she was able to stand and walk, although muscular weakness still continued for some time. By the end of November the blue line had disappeared.

Her blood count showed

Erythrocytes 3.766.666 per cubic millimeter.

Leucocytes 10.000

Haemoglobin 80 %

Color index 1.07

Basophile granular cells 6 %.

There was marked basophile granulations in the erythrocytes.

April 11th, 1905, her blood count showed:-

Erythrocytes 5.300.000 per cubic millimeter

Leucocytes 10,625

Haemoglobin 95 %

Color index .89

Basophile granular cells 4%, No nucleated reds found.

There were 4% of basiophilic granulated Erythrocytes found in the examination of fresh blood stains

after Vaughan method, using Unna's polychrome methylene blue.

Case 2.

Mrs. S., aged 29, was sent into Hospital for acute abdominal pain.

History of illness:- Patient had a child nine months old, about the middle of September 1904. She believed that she was pregnant. She took Dr. D's patent pills which she procured from a firm of well known chemists in Sheffield, for the purpose of stopping it. She took 84 in one week, then threw the remainder into the fire as she began to feel very ill, having gastric pains and severe intestinal colic and obstinate constipation. The pains radiated between her shoulders and down her back and up into her chest. She lost her appetite, had a sore throat and difficulty in swallowing about the same time turning a dirty yellow colour. Complained of breathlessness on exertion. The first attack of pain was sudden and violent; her husband found her doubled up writhing in agony on the floor. She had great difficulty in passing water; the quantity was small and high coloured. The whole of this time vomiting was persistent and troublesome. If she attempted to walk she found that her limbs would not support her, becoming giddy and faint.

Case 11

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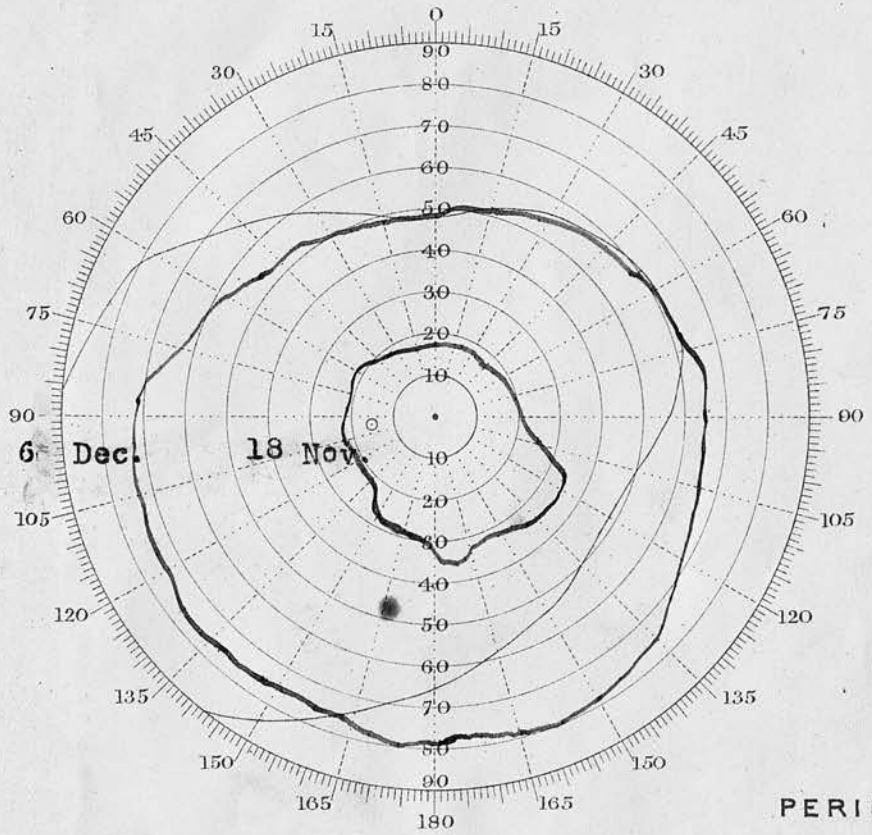

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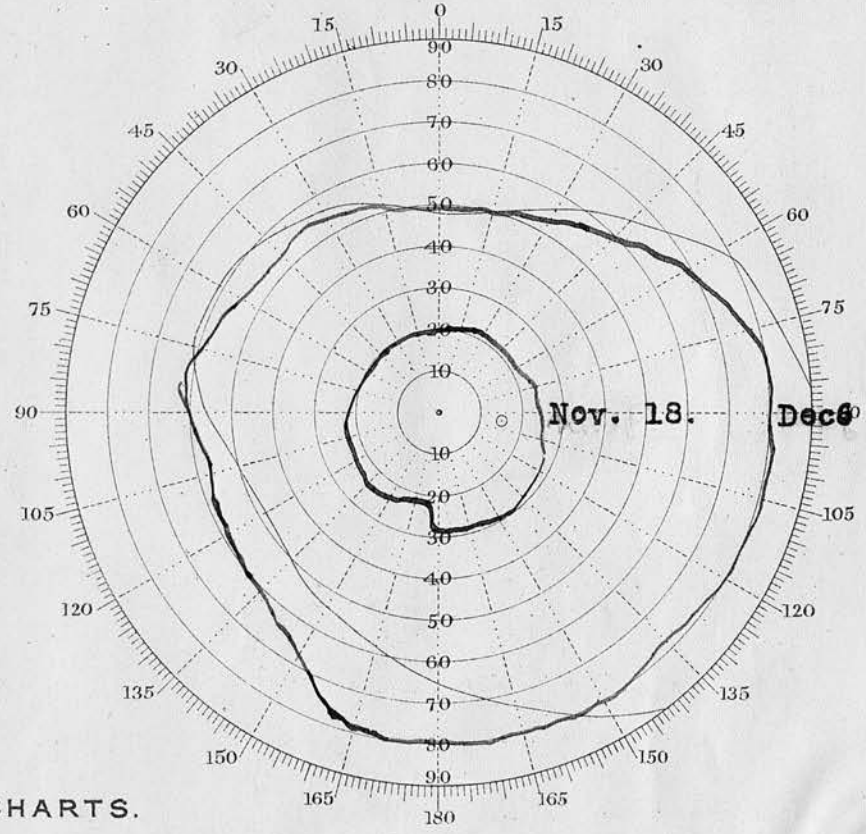

PERIMETER CHARTS.

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Designed for use with Prof: Mc Hardy's Registering Perimeter.

Published by Mess rs Curry & Paxton, 195, Gt Portland St. London, W.

She saw things double and had intense headaches. These symptoms varied for six weeks after which she was admitted to the Sheffield Royal Hospital.

Condition on admittance to Hospital, November 8th, 1904.

Patient was very sallow and cachetic. Skin was moist and somewhat pigmented, lips dry and scaly, breath metallic and offensive. Most of her teeth were carious. There was a well marked blue line along the alveolar margins top and bottom. Tongue tremulous and foul. Complained of soon being out of breath. Pupils widely dilated. They reacted well to light and accommodation. She complained of failing sight. Her general nutrition was very poor. Knee jerks were exaggerated, otherwise her tendon and skin reflexes were normal. There was no paralysis but some paresis of limbs. Tenderness over abdomen on palpation and was constipated. She complained of great pain in the pelvis. On making a vaginal examination, pain was elicited in all the fornices. The uterus was enlarged. No albumen in urine.

On opthalmoscopic examination both discs were seen to be paler than normal. A perimeter tracing showed the visual fields to be concentrically diminished as shown on chart. She complained of seeing double and different colours, such as green, blue

and red flashing before her eyes. Heart and lungs were normal.

Her blood count showed:-

Erythrocytes 3.800.000 per cubic millimeter

Leucocytes 5.312 " " "

Haemoglobin 60 %

Color index .78

Basophile granular cells 5 %.

Several nucleated normoblasts were found, there being 5 % of basophilic granules counting 1000 reds.

The blood count on April 7th, 1905 being as follows:-

Erythrocytes 4.933.333 per cubic millimeter

Leucocytes 6.000 " " "

Haemoglobin .95 %

Color index .96

Basophile granular cells 1.5 %.

No nucleated red corpuscles were found but there were 1.5 % of basophile granular reds counting 1000 reds.

Treatment was with Potassium Iodide and Magnesium sulphate on which she rapidly improved. Before December 6th the blue line had disappeared. She still suffered slightly from Vertigo and headaches but was sufficiently well to be discharged from Hospital.

The analysis of the pill that this woman had been taking was as follows, made by an expert analytical chemist, University College, Sheffield.

His Report is as follows:- "I find lead, but in only very small amount/. The ash of the pills is partly soluble in acid and partly insoluble. There is no doubt about the presence of lead in the insoluble portion, but I have a doubt about it in the soluble portion.

10 pills taken weight = 2.5577 grains = 39.4653 grains.

Metallic lead found.

Insoluble residue	0.24 m.g. = 0.0037 grains.
Soluble residue	0.14 m.g. = 0.0021 grains.

Quantity of lead in one pill.

Insoluble residue	0.00037 grains.
Soluble residue	0.00021 grains.

Case 3.

Mrs. M., aged 29, married woman, was sent into Hospital for gastric ulcer, October 11th, 1904.

History of Illness:- About the middle of July 1904, patient thought that she was pregnant. She began to take pills following which she began to vomit without any relation to food, and had pain in the chest and abdomen. She suffered from obstinate

Case III.

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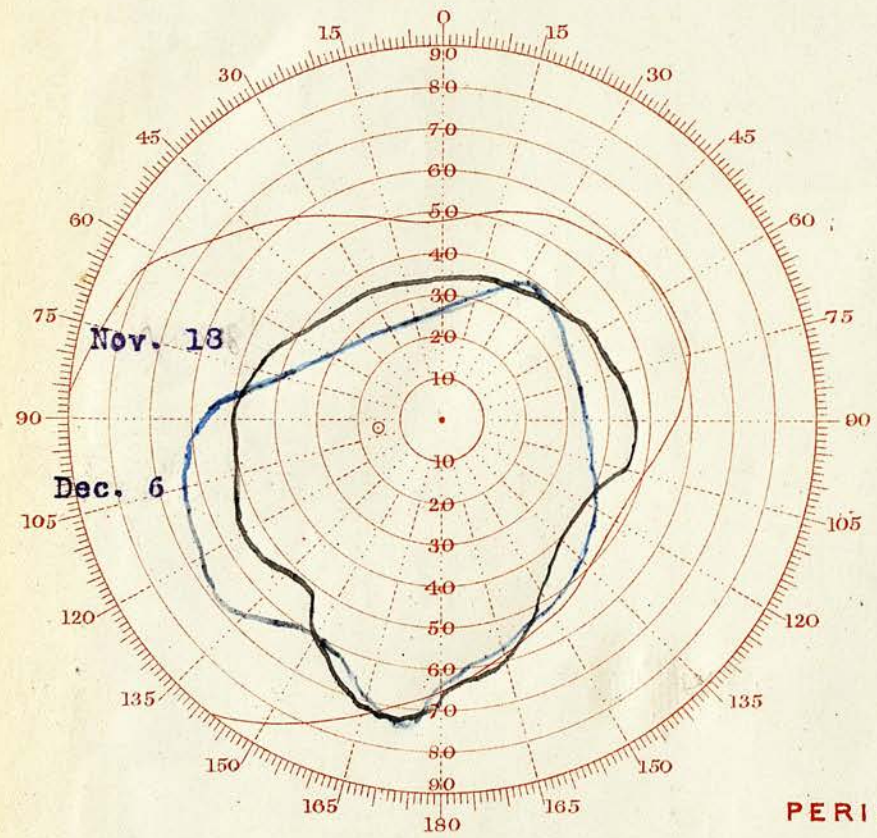

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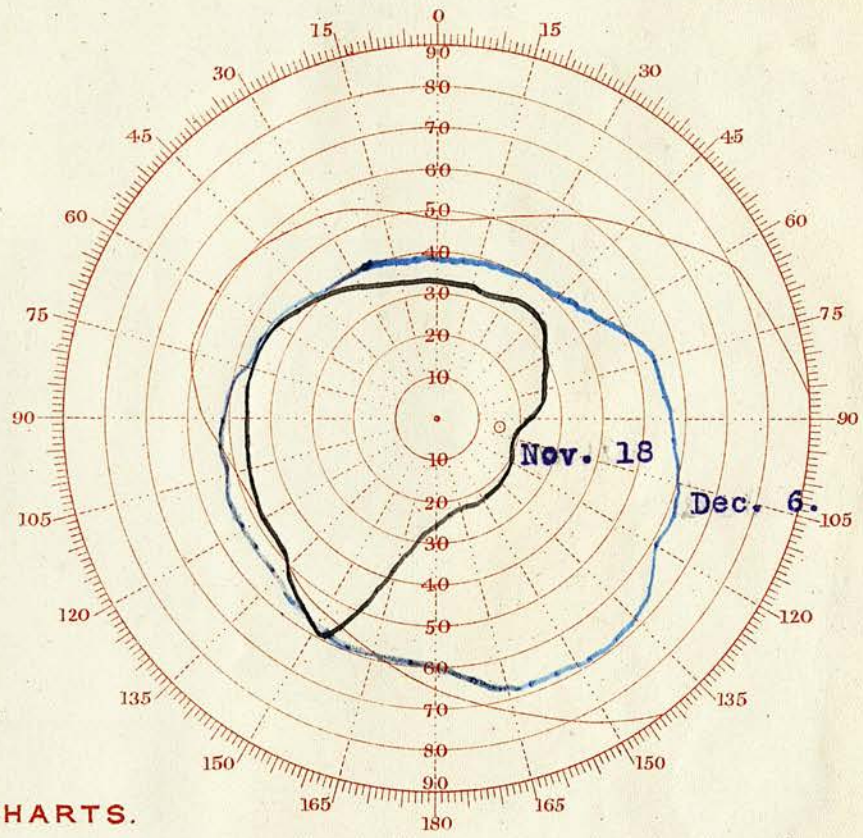

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constipation. She put herself into the hands of her medical man and was treated for gastric ulcer.

Condition on admittance to hospital:- Patient was thin and ill nourished, anaemic, lethargic and complained of intense frontal headache. Her mucus membranes were pallid. Great pain in the abdomen, flatulence and vomiting especially after food. Her breath was very offensive: lips dry and scaly, all the molars rotten. There was a well marked blue line along the alveolar margins. She had obstinate constipation. A marked feature in this case was a persistent knawing pain over the epigastrum. There were no mental complications. Her memory and intelligence were good.

She had beginning optic neuritis in both eyes. There was well marked concentric diminution of the visual fields. There was no marked paresis but complained of general weakness and inability to walk.

Her blood count was as follows:-

Erythrocytes	5.040.000	per cubic millimeter
Leucocytes	4370	" " "
Haemoglobin	.70 %	
Color index	.64	

Basophile granular cells 2 %.

There was slight poikilocytosis. Many of the Erythrocytes did not stain well.

Progress and treatment of case:-
As the vomiting was so persistent, she was kept on nutrient enemata and at times the pain was so severe that she was kept under Hyperdermic injections of Morphia for the first twelve days of treatment. The knawing pain over epigastrum and the attacks of intestinal colic made the stomach intolerant for fluid food.

Four days after admittance, she gave birth to a three months foetus.

After the first fortnight in Hospital, she made steady progress towards recovery. At no time did she show any derangement of her mental faculties.

A perimeter tracing was taken again on December 6th which showed improvement in the visual field.

Case 4.

March 8th, 1905. Mrs. W. aged 26, married, was sent into Hospital suffering from loss of use in her hands and wasting of her arm muscles.

History:- Four and a half months ago, patient was under the impression that she was pregnant. She had two children and did not wish to have any more. She bought a box of Nurse O's pills recommended to her by a neighbour, also brought before her notice by leaflets which were at intervals slipped

under her door. She took eight a day for a week. After the first two days she began to feel very ill. She had violent headaches, attacks of dizziness and breathlessness on exertion; became constipated and vomited. She lost her appetite, tongue became foul and she had a nasty taste in her mouth and suffered from general weakness and pains in abdomen.

Not having aborted after five days suffering, she bought a pennyworth of diachylon and a pennyworth of bitter oloes. To these she added two teaspoonfuls of gin and made it into pills, of which she took 34 during the next three days. The above symptoms increased in severity. She had frightful pain in the abdomen and bottom of back, accompanied by bearing down pains. On the seventh day after commencing treatment, she aborted. She seemed to improve slowly for about a month under treatment by her medical man. One morning she found that she could not use her hands or feed herself. Her shoulders and calves were very painful. All this time constipation was persistent but abdominal pain and vomiting had ceased.

Condition on admittance to Hospital:-
Patient was a fresh, healthy-looking woman. All her molars were carious. There was a well marked blue line along the alveolar margins. Her appetite was good, no pain after food or vomiting, but somewhat

constipated. No albuminuria. There was some tenderness in left lumbar region. She did not suffer from shortness of breath or palpitation. Heart was normal. Nutrition of legs impaired. She had no pain on pressure over her calves. Her shins and tendon reflexes in the legs were normal. Muscular power fair.

She had marked drop-wrist in both arms. Extensors impaired. Supinator longus normal. Wasting of interossei muscles and both deltoids. General flabbiness of arm muscles, Sufra spinatus and Infra spinatus and trapezeus on both sides very much wasted.

Pain on pressure over biceps and forearms, also over pectorals which were wasted.

Her intellectual faculties and memory were good. Eyesight not affected. Optic fields not contracted. Electrical reactions:- Faradism applied to deltoids. Sufra spinatus and infra spinatus and pectorals showed reaction of degeneration. To the extensors of wrists interossei muscles, biceps and brachialis anticus and trapizeus showed partial reaction of degeneration.

Blood count March 9th, 1905.

Erythrocytes	3.200.000	per cubic millimeter
Leucocytes	2.500	" " "
Haemaglobin	85 %	

Color index 1.32

Basophile granular cells 4 %.

Blood count April 11th, 1905.

Erythrocytes 5.400.000 per cubic millimeter.

Leucocytes 9.687 " " "

Haemoglobin 80 %.

Color index .74

Basophile granular cells .5 %.

There was slight poikilocytosis, red cells were well formed. There are basophile granulations in ½ per cent of the Erythrocytes estimated from blood films stained with Polychrome methylene blue Vaughan method.

The analysis of the pills taken by this patient and several of the other cases is as follows:-

"The box contained 36 pills, which weighed 141.4 grains; thus each pill had an average weight of 3.9 gains. My analysis of the pills shows them to contain lead to the extent of 17.5 per cent, calculated as metallic lead. Thus, the average pill would contain 0.69 grain of lead.

I have not been able to definitely decide the form in which the lead exists in the pills, but there is some evidence to show that it is there as the oleate of lead."

Label of Box.

Genuine Nurse O's Female Corrective Pills, 1/1½ per box.

Dose:- 4 night and morning.

Prepared only by Mrs. S.....

Niece of the late Nurse O.....

Box is stamped Duty 1½d

"This Stamp implies no Government Guarantee."

Case 5.

Mrs. W., aged 27, a married woman has had twins, prematurely, and two miscarriages.

History:- About Christmas time, 1904, patient became suddenly ill. She vomited persistently, became very weak, she could not stand or walk, suffered from severe headaches and dizziness, quickly got out of breath on exertion, was very constipated but had no abdominal pain. She became very pale. Subsequent partial recovery. Her present illness started two weeks ago about the middle of March with acute headache and stomach-ache and pain in the

Case V.

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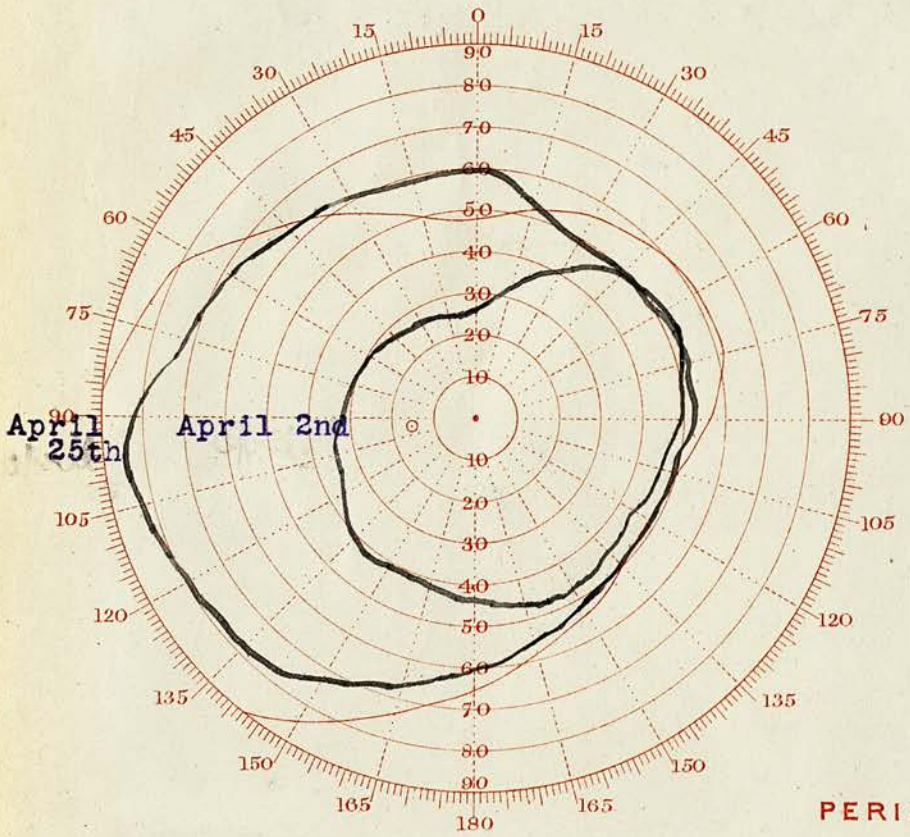

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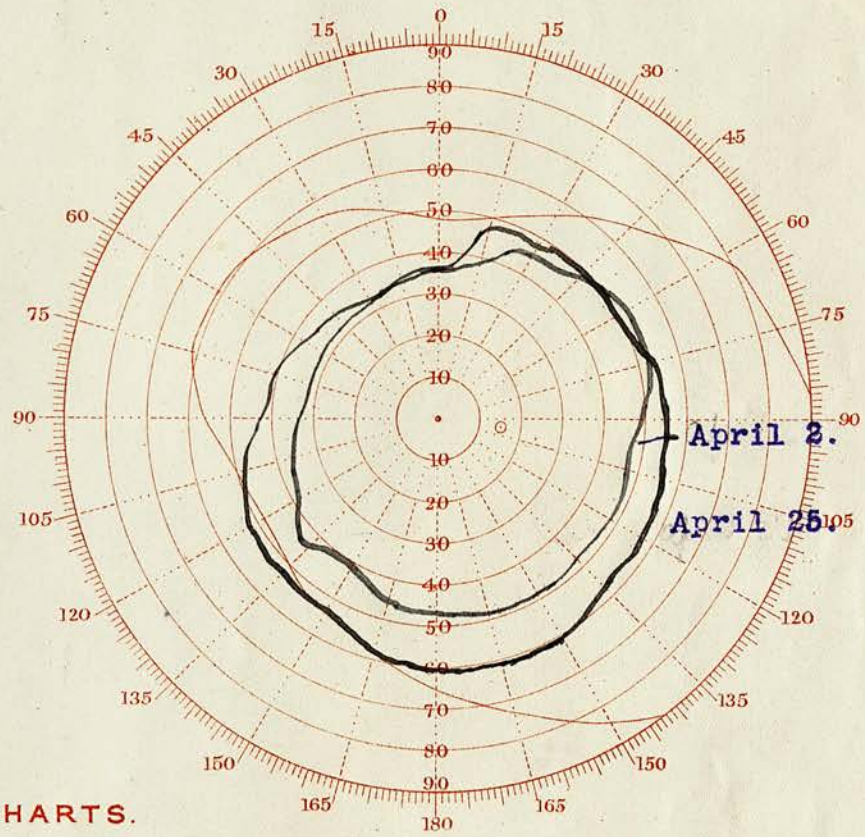

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legs, arms, shoulders and neck: had obstinate constipation and slight colic. She vomited at the outset. She was delirious for 5 days and at times was unconscious and breathed heavily. Her eye-sight subsequently failed her. She saw living, horrid, nasty things moving about on the ceiling and walls. They were white and chocolate colour, something like birds and queer animals with big eyes. Sometimes a hairy man was seen beating the wall with a stick. She had horrible dreams in the midst of which she wakened up screaming.

Present condition:- Patient was of a pale, yellow earthy colour, with pallid mucus membranes and a well marked blue line along the alveolar margins of gums. Teeth carious, tongue dirty, breath foul smelling, bowels constipated and some tenderness about the umbilicus on palpation of abdomen. Heart, liver, spleen and lungs were in a normal condition. Knee reflexes were abolished: planter reflexes brisk. The muscular power of legs good. Grip of both hands weak. Pain in wrists and arms. Extensors weak. There was wasting of shoulder and back muscles, especially the left deltoid. There was a well marked right internal squint. She cannot see plainly, complains of failing sight. There was double optic neuritis. The visual fields contracted. See Chart. Her blood count was as follows:-

Erythrocytes 4.533.333 per cubic millimeter

Leucocytes 2.100 " " "

Haemoglobin 95 %.

Color index 1.05

Basophile granular cells 4.7 %.

Basophile granules 4.7 % in fresh blood stained preparation. There was marked poikilocytosis. Blood plates very numerous. The polymorpho-nuclear Leucocytes varied very much in size, a large proportion being smaller than the Erythrocytes.

Progress and treatment:- She was put on the potassium iodide and iron mixture and the bowels kept in good order with magnesium sulphate mixture. As she was restless and wakeful at night she was given one drachm and a half of Bromidia. She frequently, during the first few nights, screamed out in terror, as she saw frightful figures of men's and cows' heads grouped round her bed associated with bloody sights. She had auditory hallucinations also. She was hearing foul language and the crying of children. At other times she saw strange and weird animals crawling about the ward.

Massage and the battery were applied to the weakened muscles.

For three weeks after admittance, her sleep was broken by horrid sights and night terrors at times. She steadily improved in her general health

Blood condition April 23rd, 1905, 3 weeks after admittance.

Erythrocytes	4.850.000	per cubic millimeter.
Leucocytes	5937	" " "
Haemoglobin	95 %	
Color index	.97	

Basophile granular cells .8%.

There is slight poikilocytosis. Blood plates numerous and granular.

Case 6.

A married woman, aged 28, Has 3 children. Sent into Hospital for gastric ulcer on March 20th, 1905.

History of present illness:- About 7 months ago patient began to have pain in the abdomen almost continuously but more pronounced after taking food, followed by vomiting. From the beginning she was constipated. Nine weeks ago her symptoms became much worse. She had frequent fainting fits and became unconscious and at times was delirious. She asserts that about the same time she vomited blood, about a teacupful, which tasted very bitter. For 3 months she has suffered from occipital headache which was worse in the morning, accompanied by ringing noises in her ears. Her water was thick, highly coloured

and scanty in quantity. Most of this time she has suffered from amenorrhoea. For 2 years past she has been in poor circumstances and been badly nourished. She did not want any more children.

Condition on admittance to Hospital:-
She has a poor appetite. Does not vomit after food. The mucus membranes are pallid. There is a marked blue line along the edges of the gums, and the teeth are carious. The tongue is thickly furred. The breath has a foul metallic smell. She is obstinately constipated. There is pain about the umbilical region but not increased on pressure.

She complains of having lost a good deal of flesh and becoming weak and inability to walk or even to stand. She is anaemic and pasty in appearance. At times suffers from palpitation and breathlessness. She sleeps badly and has frightful dreams. Her intelligence and memory good. Has no hallucinations. Sight is not affected. The optic discs are pale, the fundus normal. A perimeter tracing does not reveal any diminution of the visual fields. There is no squint or paralysis.

Her blood condition is as follows:-

Erythrocytes	4.350.000	per cubic millimeter
Leucocytes	2.500	" " "
Haemoglobin	55 %	
Color index	.63	

Basophile granular cells 3 %.

Basophilic granulated red corpuscles are numerous, also basophilic granulated Erythroblasts.

There is some poikilocytosis, moderate in amount.

Treatment and progress:-

Patient was put on the potassium iodide mixture and magnesium sulphate. Has steadily improved except for an acute follicular tonsilitis which gave way to a gargle and a mixture of sodium salicylate and Tincture of Quinine and Ammonia.

Her blood condition on the 3 weeks after admittance showed

Erythrocytes	4.433.333	per cubic millimeter
Leucocytes	5625	" " "
Haemoglobin	80 %	
Color index	.90	

Basophile granular cells 1.2 %.

There is no poikilocytosis. The red corpuscles are well formed.

Case 7.

A woman, 37 years of age, has one child, sent into hospital for persistent weakness and headache.

Case 111

"Centre each chart with "pointer" at Zero before commencing to use the Automatic Registration".

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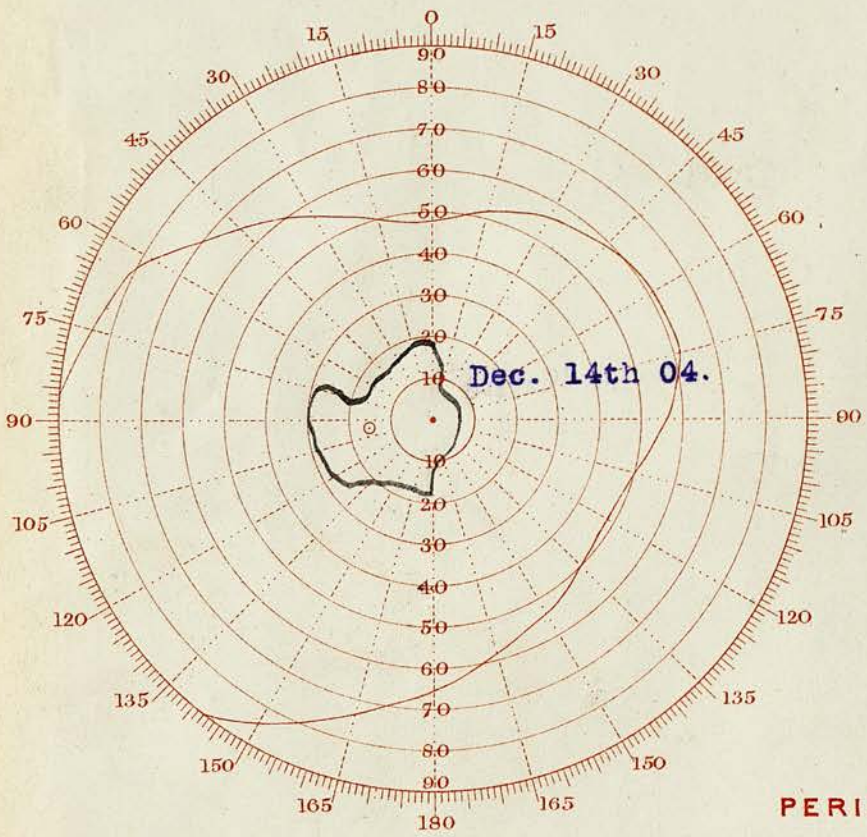

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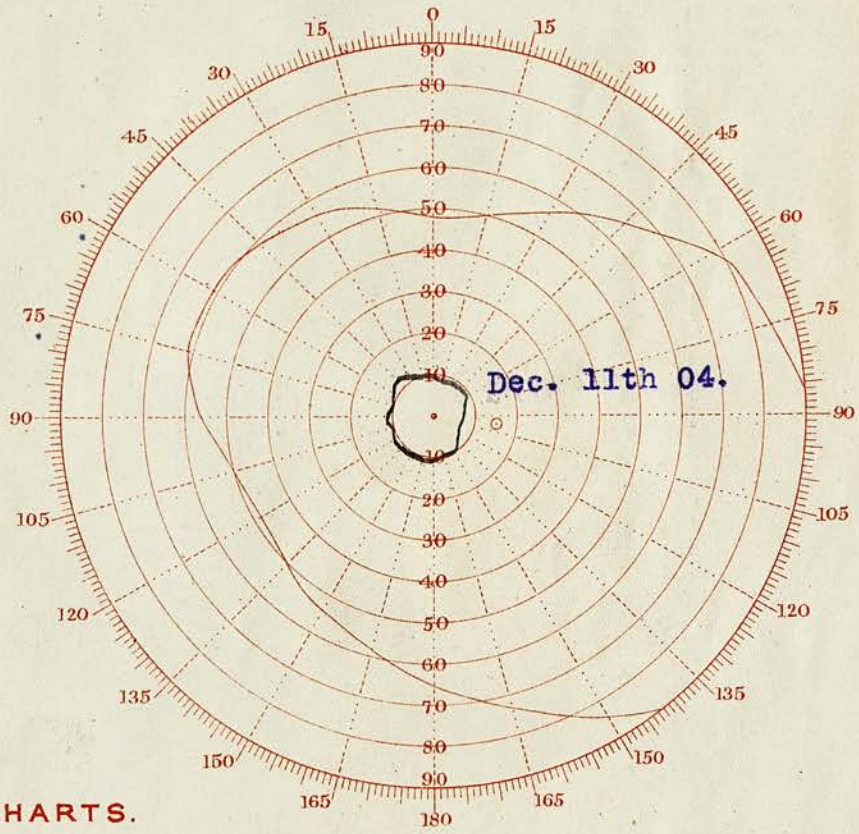

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December 5th, 1904.

History:- Patient has been taking Dr. Ps corrective pills, two at bed time, for some weeks. Exact length of time not known. She contracted severe stomach-ache and had to give up work because of dizziness and palpitation. Both legs began to swell and she had headaches and was breathless on exertion.

Condition on admittance:- Legs were not swollen She had no pain in her limbs. She was anaemic. Her teeth were carious. She had a marked blue line on gums. There was no vomiting and no pain after food. Offensive breath. She was not constipated. There was loss of knee jerks. She had a feeling of pins and needles in both feet and legs up to her knees. Her hands felt numb and weak, she was unable to hold anything for even a short time. Heart was normal. She had no albuminuria. on opthalmoscopic examination. The discs were much paler than normal and sharply differentiated. The perimeter tracing showed very marked concentric diminution of the field of vision In the right eye a field of 10^{o} was mapped out and in the left eye a field of 10^{o} - 30^{o} was mapped out. See chart.

Treatment:- She made a very good recovery under the Potassium Iodide and Magnesium Sulphate treatment and rest in bed.

Her blood count on December 5th, 1904 was as follows:-

Erythrocytes 4.800.000 per cubic millimeter

Leucocytes 10.000 " " "

Haemoglobin 85 %

Color Index .88

Basophile granular cells 1 %.

There was slight Poikilocytosis in shape and size of cells and some paleness in staining power.

Case 8.

Mrs. C. a married woman, aged 23, with one child, attending the out-door department of the Sheffield Royal Hospital. January 12th, 1905.

History:- Six months ago patient had been attending this department for lead poisoning and had greatly improved under treatment. She was now attending for a recurrence of her illness.

Last June she began to have pain in the stomach and was constipated. Had violent headaches and vomiting. Had no weakness of limbs or paralysis. Rapidly improved with Potassium Iodide and Magnesium Sulphate.

Present illness:- About the 23rd December, 1904

she began to have pain in stomach, headache and some dizziness. The colicky pains lasted about five minutes at a time. There was no vomiting, palpitation or loss of memory. Her eyesight had not failed her and she had no weakness of her limbs. She did not think that she was pregnant but did not deny the possibility of becoming so. Her husband was in the Navy and had not been home for about 12 months. She denied having taken pills or medicine or lead in any form.

A well marked blue line was present on the gum margins on the upper and lower jaw.

She was waxy pale with pallid mucus membranes. Tongue clean, foul breath, appetite good.

There was no constipation, no vomiting or head ache for the past week. About that time she had menstruated. Her eyesight was good. A perimeter tracing showed a normal visual field in both eyes.

Subsequent History:- As patient was attending the out-door patient department, we could not observe her progress satisfactorily. She came up week by week for her medicine, which was made up of the following drugs:-

R.	Potassium Iodide	gr V.
	Ferri et ammonii citras	gr V.
	Spiritus Chloroformi	M. V.
	Tincture nucis vomicae	M. V.
	Aqua ad.	℥ ¼.

Sig. ℥ ¼ t.i.d; P.C.

R. Magnesii Sulphas· ℥ ℈.
Acidium Sulphuricumdil M. X.
Syrupus Rhoeados ℥ SS.
Aqua Menthae Viridis ad ℥ ℈.
Sig. ℥ ℈. O,M.

The account I got from her friends was as follows:- On March 20th, 1905, she had a fit, became unconscious. Her right arm worked. She foamed at the mouth but did not bite her tongue, and became quite stiff all over.

The following day she had a fit.

The following week she had another fit.

Her appetite was quite gone. She was very constipated. Had severe headaches, also pain in stomach. Her wrists were very weak. She could not hold things in her hands, was tremulous, was menstruating regularly. Had lost control of her bladder. Nothing wrong with her eyesight. Intellect was quite clear was not delirious, was vomiting frequently.

On the 3rd April she died in a fit.

The coroner ordered an inquest to be held, the result of which was as follows:-

There was a marked blue line on alveolar margins on top and bottom jaws. The left ventricle of heart was hypertrophied.

There was no atheroma of vessels.

Liver appeared normal.

Both kidneys were spotted over with small cysts about the size of a pea, and the capsules were slightly adherent to both kidneys.

Uterus was small and hard.

Brain appeared normal.

Intestines were pale and rugae tipped with yellow but no blackening.

Stomach was contracted about its centre giving the appearance of a slight hour glass contraction. Mucus membranes were pale.

Her blood in March, 1905, showed

Erythrocytes 3.900.000 per cubic millimeter.

Leucocytes 5.200 " " "

Haemoglobin 65 %.

Color index .83

Basophile granular cells 4.9 %.

She had moderate poikilocytosis. Several nucleated cells were found in the blood smears, about 1½ %, and well marked basophile granulations in the erythrocytes.

Case 9.

Mrs. S., aged 47, married, has had 15 children, one miscarriage. April 14.

History of present illness:- About 3 months ago, as patient did not menstruate, she believed that she was pregnant. As she already had had 16 pregnancies, she resorted to Nurse O's pills, noted for their correcting properties. She took 2 boxes of these, 8 a day, in all 72 pills. In a week's time she began to feel very ill. She became weak, lost her appetite, vomited violently. Bowels were not constipated at the onset of her illness but were subsequently. She was very thirsty and drank large quantities of water. She vomited daily for 3 months and was confined to bed. She had griping pains in the abdomen especially about the umbilicus and epigastrium. Latterly she became constipated. Headaches became more severe, frequently became faint and lost balancing power and ran off in flesh.

Condition on admittance to Hospital:- Patient has a yellowish sallow appearance. Her nutrition is fair but she has lost flesh. All her molars are carious. There is a deeply marked black blue line along the edges of upper and lower gums. Her tongue is large, flabby and dirty. The breath has a metallic and foul odour with almost complete loss of appetite. The vomiting is persistent, espe-

cially marked after taking food. The constipation is stubborn, at times has attacks of intestinal colic. The pain over the abdomen is constant but not acute. On palpation she seems relieved.

The eyesight is not affected. She has not had any squint. A perimeter tracing shows normal visual fields. The conjunctivae are somewhat yellow. On opthalmoscopic examination both discs were found to be pale and the vessels small.

There were no tremours or special wasting of muscles but some weakness and numbness of right arm. She has some difficulty in making water, which is scanty and high coloured.

Her blood count was as follows:-

Erythrocytes 4.416.666 per cubic millimeter

Leucocytes 3125 " " "

Haemoglobin 70 %.

Color index .78

Reds with basophilic granules 4.9 %.

There was marked basophilic granulations in the Erythrocytes and moderate poikilocytosis.

Treatment and progress:-

As her vomiting was so stubborn, on admittance she was put on an effervescing mixture until it was arrested and the bowels were moved by simple enemata. After the first 4 or 5 days her milk diet

was gradually added to until she could take ordinary Hospital diet without discomfort and retain the potassium iodide mixture with iron and the magnesium sulphate mixture. Her progress towards convalescence was good.

Her latest blood count showed:-

Erythrocytes	4.583.333	per cubic millimeter
Leucocytes	6875	" " "
Haemoglobin	75 %.	
Color index	1.05.	
Basophile granular cells	3.3 %.	

The basophile granular cells are decreased since the first count. Poikilocytosis is moderate in amount and degree.

TABLE OF SYMPTOMS. I.

Number.	Age.	Occupation.	General Appearance.	History.	Abortion.	Blue lime.	Teeth.	Breath.	Appetite.	Vomiting.	Constipation.	Pain in Abdomen.	Albumen.
1.	28.	Housewife.	Cachectic wasted.	Taking pills to produce abortion.	September.	x	Carious.	Foul.	Loss complete.	x	x	x	-
2.	29.	Housewife.	Degraded yellow. cachectic.	Pills for abortion.	-	x	x	Offensive metallic.	Loss.	x	x	x	-
3.	29.	Housewife.	Anaemic, lethargic.	Pills for abortion.	Oct.16th in hospital.	x	x	Offensive.	Impaired.	x	x	x	-
4.	26.	Housewife.	Healthy in appearance slight pallor.	Pills for abortion.	Aborted at home.	x	x	Offensive.	Impaired.	x	x	x	-
5.	27.	Housewife.	Sallow earthy look.	Taking various pills denies for abortion.	-	x	x	Offensive.	Impaired.	x	x	x Umbilical.	-
6.	28.	Housewife.	Pasty and lethargic.	Has taken patent medicines denies for abortion.	-	x	x	Foul. Metallic.	Impaired.	x	x	x Umbilical.	-
7.	37.	Housewife.	Anaemic.	Corrective pills.	-	x	x	Offensive.	Impaired.	x	x	x	-
8.	23.	Housewife.	Waxy.	Denies taking patent pills.	-	x	x	Offensive.	Impaired.	x	x	x	- Doubtful.
9.	47.	Housewife.	Sallow.	Took pills for abortion.	-	x	x	Offensive.	Impaired.	x	x	x Umbilical.	-

TABLE OF SYMPTOMS. II.

Number.	Age.	Muscular power.	Grasp. Drop wrist.	Gait.	Knee jerks.	Vertigo.	Arthralgia.	Paralysis.	Delirium.	Fits.	Persecutions & delusions.	Melancholia.	Memory.
1.	28.	Complete loss.	Great weakness.	Could not stand.	Normal.	x	Shoulder & Elbow.	-	Maniacal.	Epileptiform.	x	Marked.	Complete loss.
2.	29.	Weakened.	Weakened.	Loss.	Exaggerated.	x	-	-	-	-	-	Depression.	Partial loss.
3.	29.	Weakened.	Weakened.	Difficulty in walking.	N.	x	-	-	-	-	-	Depression.	Good.
4.	26.	Weakened and wasting of muscles of arms & chest.	Double Drop wrist.	Weakened.	N.	x	Shoulders & elbows.	Came on after abortion.	-	-	-	Slight.	Good.
5.	27.	Weakness in legs, arms, shoulders. wasting of deltoids.	Weakened extensors of wrist.	Weakness.	Abolished.	x	Wrist, elbows shoulders.	-	x for 5 days.	-	Horrid sights about her.	Depression.	Loss.
6.	28.	Weakened.	Weakened extensors of wrist.	Weakness.	N.	x	-	-	Slight.	Fainting.	-	Depression.	Good.
7.	37.	Weakened.	Weakened extensors.	Normal.	Loss.	x	-	-	-	-	-	Depression.	Good.
8.	23.	Weakened in last 2 weeks of her life.	Drop wrist before death.	Could not walk for last 2 weeks.	N.	x	-	-	-	Marked.	-	Latterly.	Good.
9.	47.	Weakened.	Weakened.	Could not stand.	N.	x	-	-	-	-	-	Slight	Good

Number.	Age.	Loss of Sight.	Diplopia.	Shadows and Darting Lights.	Optic Neuritis.	Optic Atrophy.	Perimeter Optic Fields.	Speech.	Tremours.
1	28	Right eye.	+	+	+	-	Normal	Loss	+
2	29	Failing	+	+	-	Pale discs.	Concentric contraction	-	+
3	29	Did not complain.	-	-	+	-	Concentric Contraction.	-	-
4	26	Not affected.	-	-	-	-	-	-	-
5	27	Partial failure.	Internal squint right eye	-	+	-	Concentric Contraction.	Partial loss.	-
6	28	Not affected.	-	-	-	Pale discs.	-	-	-
7	37	Not affected.	-	-	-	Pale discs.	Marked Concentric Contraction.	-	-
8	23	Not affected.	-	-	-	-	-	-	+
9	47	Not affected.	-	-	-	Pale discs.	-	-	-

From the foregoing cases and tables it will be noticed that two of the cases aborted in Hospital and one before she was admitted. Numbers 1, 3, and 4, succeeded in producing this result. Numbers 2, 7 and 9 thought they were pregnant and took corrective pills to bring off abortion, which failed as there was no foetus, amenorrhoea having come on from other than physiological causes. No. 9 is 47 years old and on the brink of the menopause, but dreaded another pregnancy before it was fully established. The other three admitted buying patent pills but which are not supposed to have ecbolic properties, although they are strongly suspected and I believe with very good reason of having taken abortifacient pills from their knowledge of these things and the evidence of their medical attendants. It is difficult to get a truthful history from all of these patients as they know it is an offence - and a serious one - against the law, to procure abortion, so it is not supprising if they withhold the truth on this matter.

All these women were married and had families, admitting that they had no desire to increase them. They were at the vigorous child-bearing age between 23 and 29. One was 37, another 47 years old.

Symptoms:-

The symptoms in lead poisoning, especially in early acute cases, often suggest abdominal disease and have frequently led to errors in diagnosis. The gastric pain and intestinal colic point to some acute abdominal mischief, especially when accompanied by vomiting and obstinate constipation, preceded mostly by pallor of the skin and loss of appetite. The breath in all my cases was foul-smelling and of a curious metallic odour, there being at the same time a disagreeable taste in the mouth which was particularly complained of in several cases.

The colic becomes more frequent as intoxication increases, not always accompanied by constipation which may appear later. No. 9 suffered for weeks before she was troubled in this manner, then it was of a very obstinate character. In 3 of the cases they specially noted tenderness and pains about the region of the umbilicus which was described as dull and aching and gnawing in the case of No. 3.

As the patient becomes more deeply under the influence of lead, the paleness of the face passes into a sallow, earthy look, eventually into profound saturnine cachexia.

Along the alveolar margins of the gums the characteristic blue line appears, which in every case has confirmed the diagnosis .

Four of my cases were sent into Hospital with a

wrong diagnosis. Two as gastric ulcer, one as gastric catarrh, another for persistent abdominal pain and weakness. On the discovery of the blue line, the diagnosis was complete. This routine examination of the teeth and gums has thrown light upon many obscure cases of anaemia, especially in this district where widespread harm has been done to the public health through the ravages of lead carried in the drinking water; also in file cutting by hand. Happily these causes may be said to exist no longer but no less an obvious cause is rapidly on the increase. Every case of lead poisoning by pills that has come under our notice, has presented the blue line. The pseudo-blue line has on more than one occasion been mistaken for the real blue black line studded with minute black spots along the thin edge of the gum margins. These can readily be detected with a small magnifying glass. On cleaning the teeth this pseudo-line disappears, leaving the gums clean. If not the diagnostic blue black line is found and cannot be mistaken.

The teeth of all the patients, without exception, were carious, dirty and in bad condition.

This detection would be rendered difficult were it not for the fact that Hospital patients do not keep the teeth clean and free from tartar which evolves the sulphuretted hydrogen, it in turn combining with the lead to form the black sulphide.

The blue line, under treatment, disappears along with the general improvement of the patient. Except in the case 8, in which it not only persisted but became more marked up to the time of her death, although she denied taking pills or lead in any form. The cachexia also becoming more profound giving conclusive evidence that lead was still being absorbed from some source.

Nutrition was markedly affected in most of the cases, No. 9 least of all, accompanied by loss of desire to take food.

Roberts states that lead has a tendency to alter metabolism by crystallizing urates in the fluids and tissues of the body, and it has been pointed out by Garrod that lead hinders normal excretion by diminishing the alkalinity of the blood and lessening the solubility of uric acid. This view is strengthened by the fact that lead encephalopathy has been described by Oliver without the slightest trace of lead in the brain, thus pointing to altered elimination by the liver and kidneys.

The Nervous system:-

That lead toxemia has a peculiar and far reaching influence upon the nervous system is well known. Both the central and peripheral systems suffering in varying extent: there being scarcely 2 cases following precisely the same set of nervous symptoms: no part of the nervous system being exempt from its malign effects. In the early stages, and through the illness, headache is a constant feature coming on at intervals without warning and varying in intensity and duration.

Lead encephalapathy including all head and mental symptoms and psychological disturbances which are diverse and frequent, ranging from attacks of giddiness to acute maniacal insanity, ocular symptoms are common, amaurosis, visual illusions, aural hallucinations, fits, loss of memory, drowsiness and sleeplessness, often accompanied by loss of memory, confusion of ideas and inability to sustain attention and answer questions coherently, followed by depression and lethargy. In two of the cases there was visual and auditory hallucination, with terrors which usually came on at night followed by fits of screaming as in the case of [illegible] and 5. They heard voices and saw sights that were horrible followed by maniacal outbursts from No. 1 and extreme restlessness on the part of 5. All but one

of the patients were more or less dull, apathetic, pale and anxious, mostly about their children and domestic affairs, not usually about themselves, except in the case of No. 1. who was under the impression that she was to be punished for committing an offence which she had not done and that she was being persecuted and harried by people who hated her. Suddenly, without warning, she would start up in bed, screaming with terror and plead that she had not done it - not naming her offence. These attacks lasted from half an hour to 5 or 6 hours, until she was quite exhausted, followed by restless sleep and delirium.

Speech was affected only in two cases. No. 1 would lose her speech for days together and No. 5 spoke in a slow incoherent manner during the first week of her stay in Hospital.

Tremours of tongue and muscles were shown in four of the cases. All suffered from vertigo and general weakness of the muscular system, No. 8 only during the last 2 weeks of her life. The tendon reflexes were normal in most of the cases. No. 2 had exaggerated knee jerks and in No. 5 and 7 they were abolished.

Nos. 1, 4, 5, complained frequently of arthralgia in their shoulders, elbows and wrists, which was not constant. Associated with this they had weakness of the extensors of the forearm. There was

marked drop wrist in 4 and 8 and wasting of the interossei, extensors of forearm, deltoids, supra and infra spinatus, trapezius and pectorals in No. 4. These muscles gave in varying degree the reaction of degeneration, e.g. marked loss of faradic excitability and the galvanic giving increased contractility of muscle.

No. 5 had wasting of deltoids. In both these cases there was a history of rapid wasting.

In the two cases, Nos. 1 and 8, there were epileptiform seizures. No. 1 almost lost her life; she passed through a very critical time. No. 8 died in a fit, on whom a post-mortem examination was held. The first one has become a melancholiac, dreading the company of other people and shunning that of her nearest friends as much as possible.

What is the cause of this sudden maniacal outbreak? Here is a young woman, 28 years of age, apparently in good health takes a few pills containing lead, suddenly struck down by one of the most violent attacks of madness necessitating the use of restraint. The question has arisen more than once, has lead a special predilection for the nervous system in certain individuals? If so are we to regard convulsions and maniacal outbreaks as due to direct irritation of lead on the nervous system, or, as in the case of uraemia due to auto-intoxication from the retention of harmful substances due to

defective renal metabolism.

In No. 1 they were an early symptom; in 8 they did not come on until the last fortnight of the patient's life. The urine of No. 1 at no time showed any signs of albuminuria or renal complications. As much for No. 8 cannot be said as she was an out-patient and it was impossible to watch the condition of her kidneys week by week. These epileptic attacks are said to involve an unfavourable prognosis and to be especially associated with abortion ending often in delirium and death.

The gait in all of the cases was affected. There was loss, more or less, of the power to walk, but nothing characteristic in the gait, brought about principally through the weakness of the muscles of the lower limbs and body and peripheral neuritis.

Ocular symptoms:-

In cases of lead poisoning are numerous and diverse. There is nothing characteristic or constant in the eye symptoms. We are reminded that they may be associated with and depend in a measure on some kidney lesion.

In the cases here recorded, not one has exhibited albumen in the urine or any gross renal complication except, perhaps, case 8 whose urine was examined three months before her death and was found to be normal. The post mortem examination revealed slightly systic and granular kidneys; at the same time she did not complain of failing eyesight.

The opthalmoscopic appearances were very slight. They did not simulate the retinitis of Bright's disease in any case so that the eye lesions were in every probability not connected with renal troubles. Some deny the existence of a separate specific lead neuritis and Oliver[XI] states that the affection is always connected secondarily to albuminuria, an effusion into the ventricles of the brain and subarachnoid spaces or accompanying suppression of menstruation. The vision in three of my cases showed partial failure and was accompanied in case 1 by acute exacerbation of the disease with improvement in a few days' time. This transitory amaurosis is interesting since its pathology is so little understood, it being undecided whether dependent on some

cortical process or upon a hydrops of the optic nerve tissue.

In three of the cases, 1, 3, and 5, there was a suggestion of early optic neuritis, especially in No. 1 where grave mental symptoms and acute maniacal encephalopathy were exhibited, the borders of the disc being swollen, ill-defined and irregular, and the vessels somewhat obscured. Four cases showed undue paleness of the discs but not definite optic atrophy.

In 1 and 2, the patients complained of diplopia and darting lights before the eyes and flashes of colour.

Concentric contraction of the fields of vision was particularly well marked in four of the cases, 2, 3, 5 and 7. The others were normal. The fields were taken on admittance to Hospital and again before the patients were discharged. The charts show a well marked improvement in every case but one where the patient hurriedly left Hospital. This was of great importance and assisted materially in the prognosis of the case, as two of these cases had distinctly pale discs but the vessels were not contracted. They were all concentrically diminished from the periphery, almost equally round the circumference towards the centre, except the right eye of case 3, which revealed homonymous hemianopsia, the loss of sight being on the nasal side. This case

showed very marked improvement when discharged from Hospital.

Two of these cases, Nos. 2 and 5 complained of failing sight. There was no central scotoma noted in any of the cases.

No. 5 had a marked convergent stabismus of the right eye with partial failure of her sight, early double optic neuritis and contracted fields. This is the only case that had any affection of the extrinsic muscles of the eyes and that was the right external rectus; bearing out the statement that the 6th nerve is less resistant to the action of lead than any other of the cranial nerves.

CONCLUSIONS

That patent pills containing a minute quantity of lead act as effectual abortifacients but with terrible results on the general health and endangering life. That abortion precedes the more severe nervous symptoms.

That more or less permanent depression of spirits and misery associated with general ill health result from the criminal attempts to limit families, and restricts the usefulness of the individual.

That all these cases showed marked pallor and signs of anaemia and general ill health, with weakened power to walk and impairment of muscular power and strength.

That paroxysmal attacks of colic and pain are intimately associated with constipation, pallor and gastric disturbances.

That impregnation with lead is a contributory factor in the causation of insanity and brain disease.

That the mental symptoms may be grouped as follows:-

1. Those with hallucinations sight and hearing are more chronic in nature but may be recovered from.
2. That the delusions are mostly those of persecution and the fear of bodily harm.
3. That in most cases of mental derangement the tendency is to recover.

That there is frequently a history of temporary failing sight and that this is not necessarily of renal origin, but due to the selective power of lead toxemia on the nervous system.

That the more chronic type leads to affections of the peripheral nerves which affects the posterior interossei nerves and causes wrist drop and paralysis or weakness of the extensors of forearm. That there is a selective action for the nerves and muscles supplying the arms and trunk.

Treatment of lead poisoning cases.

The treatment pursued in this series of cases has been mainly expectant but from the outset where the patient could tolerate potassium iodide, magnesium sulphate and iron, they have been prescribed. Constipation from the beginning of treatment had to be arrested in almost every case. As elimination from this channel must be regarded as of first importance and the kidneys to less extent, Dixon Mann (8) asserts "that when a medicinal dose of soluble lead is administered about half or two thirds of it passes in an insoluble form directly through the bowel without being absorbed; and what remains is gradually eliminated in the faeces and urine, a small percentage being probably retained in the tissue for an indefinite period."

His experiments showed that the daily elimination in the faeces was from 5 - 10 times greater than in the urine. The amount of lead in the faeces varied from 3 milligrammes of metalic lead down to a mere trace. The largest amount obtained in one day was 0.9 milligrammes.

Potassium Iodide in combination with Tincture of Nux Vomicae and Iron was given to all as soon as vomiting was arrested and they could tolerate medicines by mouth. Until then rectal feeding in

several cases was resorted to. In the case of acute maniacal encephalapathy this mixture was withheld until the very acute stage was passed.

For the acute attacks of gastric and intestinal pain and mania, subcutaneous injections of morphia were given, also Tincture of Opium with Castor Oil.

The granules in the blood begin to disappear in number about the first or second week after treatment has begun. Here, therefore, is a proof of the good effects of the drugs used from a clinical blood analysis standpoint. They were placed on the most liberal diet that could be assimilated, milk, beef-tea, eggs, in addition to the Hospital diet.

In most cases massage was employed especially where muscles were wasted or weak. The Faradic battery was used to keep up the irritability of the muscles while the nerves were recovering from peripheral neuritis. For sleeplessness an occasional dose of Bromidia, drachm and a half was given.

Complete rest in bed was insisted upon until pain had quite gone and nutrition improved.

When these cases first began to come to Hospital for treatment, the physicians were somewhat perplexed as to the origin of these sporadic cases of lead poisoning. The drinking water was analysed for the presence of lead, this being thought of first as the town had suffered from this source of poisoning. Their occupations, trades and habits threw no light on the source of their illness. The City Analyst failed to localize the mischief. The Medical Officer of Health also pursued the problem, but was not able to throw any light upon it. A number of cases had been reported to him and carefully investigated by his officers. He furnished Dr. Hall (9) with a list of these cases. He noticed that they were all women at a child-bearing age. None of them were file-cutters or worked in lead. The cases multiplied. After some time a case was found which admitted taking pills, for she was pregnant. A box was purchased from a firm of well known chemists in town. The wrapper with the pills advertised "Dr. D's famous female pills, are world renowned and unequalled. Dose 2 to be taken 4 times a day". They bear an address in London and are protected by a Government Stamped wrapper marked:- "This stamp implies no Government Guarantee."

The circular accompanying them advertises all kinds of pessaries and protectives.

It stated:- "They must be taken for a week before each month (the extra strong or the special strength need only be taken for four or five days) continuing them until effective. They will not injure the most delicate constitution nor infants at the breast."

There pills were analysed by a member of University College, Sheffield, an expert Analytical Chemist.[10] His report was as follows:-

"I find lead, but only in a very small amount. The ash of the pills is partly soluble and partly insoluble. There is no doubt about the presence of lead in the insoluble portion, but I have a doubt about it in the soluble portion.

10 pills taken, weight = 2.5577 grams = 39.4653 grains.

Insoluble residue	0.24 m.g. = 0.0037 grains
Soluble residue	0.14 m.g. = 0.0021 grains.

Quantity of lead in one pill.

Insoluble residue	0.00037 grains
Soluble residue	0.00021 grains.

This is an analysis of the pills that case 2 had been taking

Nos. 4 and 9 admitting taking Nurse O's pills which have a label to the following effect on each box.

Genuine Nurse O's female corrective pills

1/1½d per box.

Dose 4 night and morning.

Prepared only by Mrs. S.

Niece of the late Nurse O.

These pills are also protected by a stamped Government label with the legend

"This stamp implies no Government Guarantee."

The analysis was made by the City Analyst.

"The box contains 36 pills, which weighed 141.4 grains; thus each pill had an average weight of 3.9 grains.

My analysis of the pills shows them to contain lead to the extent of 17.5 per cent calculated as metallic lead. Thus the average pill would contain 0.69 grains of lead.

I have not been able to definitely decide the form in which the lead exists in the pills but there is some evidence to show that it is there as the oleate of lead."

No. 9 admitted having taken 2 boxes of these pills, which would amount to 72 pills in all, each pill containing 0.69 grains of lead. Therefore she had taken 49.68 grains of metallic lead within a week or two, more than sufficient to account for

for her symptoms.

No. 4 began to suffer symptoms after taking them two days. She continued to take them for 5 days, taking in all 40 pills or 27.60 grains.

She supplemented these after 5 days with diachylon and bitter aloes. She aborted in a week's time in frightful agony. She subsequently got double drop wrist and wasting of muscles of arms and thorax and probably had a very narrow escape with her life.

The comparison of the two pills analysed is striking:-

Dr. D's pill contained 0.00058 grains of lead.

Nurse O's pill contained 0.69 grains of lead. The former appears to be a very small quantity but when this is referred to the quantity of lead which causes poisonous symptoms in drinking water it will be found to be quite sufficient. Oliver (11) refers to a case produced by drinking water containing 0.0028 gr. per gallon which would amount to 0.001 gr. per diem if the patient took 3 pints of water per diem.

If she took 8 pills as recommended it would mean that she had taken .00464 grain per diem as compared with Nos. 9 and 4, 5.52 grains per diem.

Explanation of Plate.

Figure 1. Red blood corpuscles from case of lead poisoning due to taking female corrective pills. Stained with Wright's stain. Showing coarse and fine granules and their distribution. Also granular blood plates.

A. Fine granules.
B. Coarse granules.
C. Granular blood plates.

Figure 2. Red blood corpuscles from case of lead poisoning due to taking female corrective pills. Stained with polychrome methylene blue as the blood issued from the wound and studied in the wet condition. Showing the network of the cells with the clumping of the degenerated Haemoglobin in granules clinging to it.

Figure 3. Red blood corpuscles from case of lead poisoning due to taking female corrective pills. Stained with Wright's method. Showing Erythro blasts.

A. Without granules.
B. With basophile granules.
C. With basophile granules & in process of mitosis.

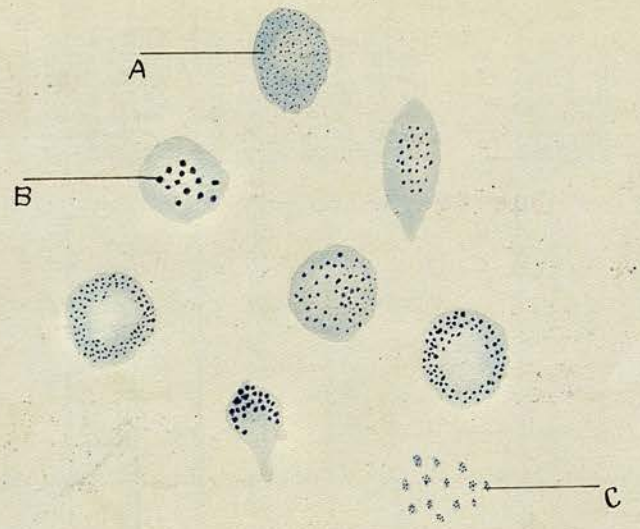

Fig.1.

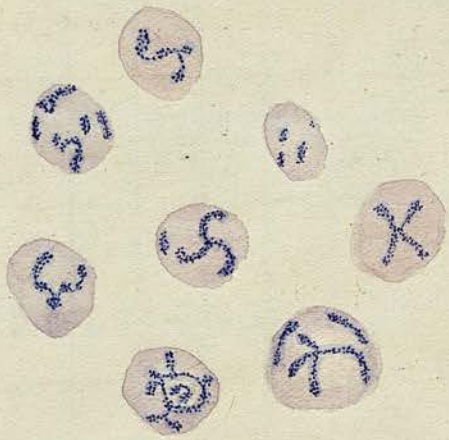

Fig.2.

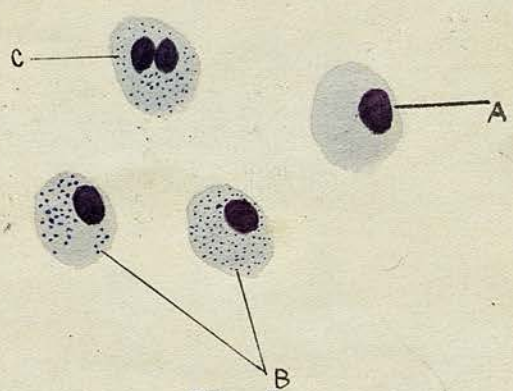

Fig.3.

Case. Date.	Red Corpuscles per c.mm.	Leucocytes. per c.mm.	Per cent Haemoglobin.	Color Index.	Per cent of red cells showing basophilic granules counting 1000 reds.	Erythroblasts.	Poikilocytosis.
1. Sept.5	2.800.000	4000	70	1.25	6	-	Moderate
Nov.30/04	3.766.666	10.000	80	1.07	6	-	Moderate.
Ap.11/05.	5.300.000	10.625	95	.87	4	-	Slight.
2. Nov.8.	3.800.000	5.312	60	.78	5	Several	Slight.
Ap. 7.05	4.933.333	6.000	95	.96	1.5	2 in Smear.	Slight.
3. Oct.11	5.040.000	4.370	70	.64	2	-	Slight.
Nov.30	5.120.000	7.200	85	.83	Several	-	-
4. Mar.2	3.200.000	2.500	85	1.32	4	-	Moderate.
Ap. 1	5.400.000	9.687	80	.74	.5	-	Moderate
5. Ap. 2	4.533.333	2.100	95	1.05	4.7	-	Marked.
Ap.23	4.850.000	5.937	95	.97	.8	-	Slight
6. Ap. 8	4.350.000	2.500	55	.63	3.	Several	Marked.
Ap.22	4.433.333	5.625	80	.90	1.3	-	Moderate.
7. Dec.5	4.800.000	10.000	85	.88	4 found in smear. 1.% in wet preparation.	-	Slight.
8. Jan.12	3.900.000	5.200	65	.83	4.9	-	Moderate
9. Ap.15	4.416.666	3.125	70	.78	4.9		Moderate
Ap.23	4.583.333	6.875	75	1.05	3.3		Moderate

BLOOD EXAMINATION.

The clinical examination of the blood in lead-poisoning cases, presents some features of special interest, especially the morphological changes in the Erythrocytes which show a certain degree of Poikilocytosis, changes in the size of the red cells, also in shape. In some of my cases this condition was not well marked. Where the cells were well formed in several instances they showed some deficiency in their staining properties, being paler than normal, at the same time not exhibiting a great decrease in their number. Poikilocytosis as a process of degeneration cannot be said to be diagnostic of any single disease of the blood or special to any one.

Nor can the finding of nucleated red corpuscles in cases of lead poisoning be diagnostic of that condition. I found them present, in small numbers, in three only out of the nine cases.

There is now another change in the Erythrocytes recognised to be present in almost all cases of Plumbism; that of the presence of fine basophilic granulations in the protoplasm of the red cells which reacts to a basic dye.

To demonstrate these granules, the blood smears have been prepared in the following manner:-

Fresh preparations were made as recommended by Vaughan, as soon as the patient was admitted to Hospital.

The technique was as follows:-

"The ear of the patient whose blood we wish to examine, is thoroughly cleaned of all dirt particles, by washing with alcohol. The blood is then drawn, the first drop being used as an index as to whether a free flow has been obtained or not. This is then wiped off with a clean towel and a drop of the previously filtered stain is placed over the site of puncture by means of a clean glass rod or pipette. The blood flowing from the wound then mixes directly with the stain without coming into direct contact with the air, and the small drop thus obtained is immediately collected on a cover glass and placed at once upon a clean slide, where, if the drop is not too large and the slide and cover glass are clean, it spreads out into a thin film and may be examined at once."

The stain used was Unna's polychrome methylene blue as prepared by Grübler.

An estimation of the red corpuscles containing granules with this method of staining, was made with a one-twelth oil-immersion lens, a black diaphragm being inserted into the distal end of the eye-piece to limit the field, counting to an average of about fifty red cells. This simplified the count and

ensured greater accuracy. In this way one thousand red corpuscles were counted and the percentage of granular cells to non-granular cells, calculated.

Vaughan (1) says:- This is the most certain method by which basic-staining granules can be demonstrated in apparently normal human blood.

Grawitz (2) in his earlier writings on the subject states that basic staining granules are not found in normal human blood but only in morbid conditions in which a degeneration of the blood cells may be assumed to be present.

Differential Leucocyte counts were made after preparing smears on glass slides in the usual manner and staining with Wright's modification of Leishman's stain, but they revealed nothing special. There was a slight variation in the percentages of the white cells.

The following table shows the results of the examination of the blood of the nine cases under consideration. The case which showed the most acute symptoms, that of maniacal encephalapathy, had the lowest number of red cells per cubic millimeter and had also the highest percentage of basophile granulations, namely 6 per cent, in a dry stained smear.

The Haemoglobin was high, thus giving a color index above the normal. This is the only case in which the red corpuscles were below 3.000,000, although in most of the cases there was very marked pallor and pronounced signs of poisoning. The per-

centage of granular cells varies considerably from 6 % down to as little as .3 %.

Only in three cases, numbers 2, 6, 8, were nucleated red corpuscles observed and in very small numbers. The basophile granules in the Erythrocytes were found to be fine or coarse, possessing an affinity for basic stains. They were also found in the Erythroblasts, there being no relation to the nucleus. In size the granules may be so fine as to be almost invisible, or large and coarse approaching the size of a eosinophile granule, rounded in shape or slightly oblong. A few of the cells contained mixed granules but generally one size is confined to a cell. There may be uncountable numbers packed in a cell or only four or five clumped together. Their distribution varies from being scattered throughout the cell protoplasm to being ranged as a ring round a pale stained centre. Then again they may be clumped in the centre or to one part of the periphery, varying in color from a light blue grey to black points.

Every kind of Erythrocyte contained them, microcytes, macrocytes, poikilocytes and polychromatophilic cells and all the observed Erythroblasts but one.

In the examination of the freshly drawn blood, recommended by Vaughan and prepared with Polychrome methyl blue, a larger percentage of Erythrocytes presented basophile granules was found but with this

difference; that they were connected by an apparently fine reticular mesh-work running irregularly through the cell, but not filling it in many instances, generally being found to one side or running across it and occupying more than one plane in the depth of the cell.

In color, with Wright's stain, they are a blueish purple. This type of granulation was seen in every specimen of blood examined but could not be demonstrated by any other method other than that of staining the blood as it flowed from the wound. When compared with a smear stained in the usual manner, they showed a higher percentage of affected cells, and in most of the cases of recovery, granular cells were found only by this method after convalescence was fully established.

The meaning and significance of these basophilic granulations in the red cells taken from the peripheral circulation in cases of lead poisoning, have been variously interpreted by investigators. The early writers on the subject, Litten, Krause, Bouchart and Vaughan, also Grawitz in his early publications, believed them to be the products of nuclear disintegration of the Erythroblasts and recently this theory has been revived by W. B. Cadwalader (3).

He says that the granules in the cases of lead poisoning have the same staining properties and are the same colour as the nuclei in the Erythroblasts

and that in some instances the Normoblasts stain poorly. The outline is indistinct, slightly ragged and decidedly granular, suggesting that particles have been broken off. In one of his cases of pernicious anaemia, he observed the nuclei breaking up and many blue-staining granules scattered throughout the protoplasm. He records 16 cases of lead poisoning in which nucleated red corpuscles were found in varying numbers containing basophile granules, and that the non-nucleated granular red cells held a definite relation to the nucleated red cells. Both decreased as convalescence was established. This association led him to believe that the granules are remnants of a pre-existing nucleus. The fact that these can only be stained with basic stains he advances as a very strong argument. In making blood counts of several of his cases, he noticed that the rise in granular cells followed the elevation of nucleated red cells e.g. they were not synchronous. The former rose as the latter fell, and that in lead-poisoning the presence of red cells in the circulation is due to some toxic effect of the drug on the Haemopoietic organs.

Grawitz (2) on the other hand, believes from his experience, that the granular degeneration takes place in the circulating blood through the influence of different blood poisons producing a defi-

nite reaction in the cell protoplasm.

He records 30 cases in all of which he found granular cells. The number of these were in direct proportion to the gravity of the disease and he believes that in no illness do these granules play so great a diagnostic and prognostic rôle as in lead poisoning.

He pointed out that there was often no other cellular change in the blood and that there were no nucleated Erythrocytes present, and when Erythroblasts were present there were no transitional stages. He also observed later that the red cells were degenerated in the same manner without the nuclei showing any sign of disintegration. The blood forming organs did not produce any change in the newly formed cells or in the Erythroblasts, so was forced to the conclusion that the origin of these granules was peripheral and due directly to the direct action of some toxin circulating in the blood. Dr. Hamel one of Grawitz's assistants, also Behrendt, were the first to demonstrate the frequency of this cellular change in cases of lead poisoning. From their observations Grawitz was led to make experiments on white mice in which he found granulated cells very early in their blood after the administration of minute doses of acetate of lead as low as .03 grammes.

Moritz (4) in a series of investigations succeeded in producing basophilic granulations in all five rabbits which he fed upon pills of acetate of lead and in one in which lead was given subcutaneously.

He further was able to support Hamel's observation that six workers in lead, only one of whom had any symptoms of intoxication, showed typical basophilic granulations of the Erythrocytes.

On the evidence of these experiments and observations, White and Pepper (5) of the University of Pennsylvania, were induced to carry on further work on the same lines. Their conclusions were as follows:-

The cases of lead poison that they examined, basophilic granulations in the red cells were an early sign in the disease, and the number of affected cells were in proportion to the severity of the case, and their disappearance was synchronous with the disappearance of the grosser symptoms of the intoxication. The blood showed slight changes from the normal; ~~of the intoxication,~~ at the same time there was a paleness of the Erythrocytes. Few nucleated reds were found. The majority of which showed granular degeneration whilst the nuclei were intact.

Their 21 cases which did not show any subjective symptoms revealed typical degeneration. One man had only worked amongst lead four days, his blood

gave definite reaction. Their experiments on dogs were conclusive . They administered lead acetate in capsules mixed with their food. Previous to this they made sure of the blood condition, that it was free from any degenerative process. In 24 hours signs of basophilic degeneration were noted, increasing rapidly as the lead was absorbed. The distribution of the granules differed from that in accidental lead poisoning. They clumped in different parts in the cell and were not scattered through it. To one of themselves acetate of lead gr.½ was administered. Granules were found in the blood 25 hours afterwards.

They also produce evidence showing that the production of granular cells is not greater in the Haemopoetic organs than in the peripheral circulation but rather the reverse.

Their conclusions regarding the source of the degeneration was that it took place in the general circulation, that it was the result of protoplasmic changes and not a consequence of nuclear fragmentation.

Their conclusions were verified by subsequent experiments by Steugel, White and Pepper (6).

They injected methylene blue into the circulation of dogs which were deeply under the influence of lead. They succeeded in finding red corpuscles degenerated on examination. Their investigation of the blood in a number of other diseases, convinced

them that no other morbid condition regularly produced basophilic degeneration of the Erythrocytes, as does lead intoxication, which is prompt and certain in its action.

In my own cases very few nucleated red corpuscles were found. They were all well formed with definite margins and showing no sign of nuclear disintegration. Most of them showed granular degeneration. The two conditions appeared to be independent of each other. It is true that the nucleated reds were found when the intoxication was most marked, but that is no evidence that there was an intimate relation existing between the two abnormal conditions. They, I believe, are independent of each other, the granular degeneration having an entirely separate existence from that of the Erythroblast, and when found in the nucleated red cell it was due to the same influences as brought about the condition in the Erythrocytes; that is the direct action of the lead toxin circulating in the blood stream.

If fragmentation of the nuclei was responsible for the basophilic granulations, there must be transitional forms found sooner or later. Considering the vast number of granular cells found in the blood, one would expect to find a corresponding number of nucleated reds, either fully formed or in process of fragmentation. This, however, is not borne out by the examination of the blood. The

question has been raised; are these basic staining granules artefacts? I think this cannot be seriously entertained, considering the regularity of their appearance in every morbid condition in which they are found; also the character of the granules themselves. When freshly drawn blood is stained and examined in the wet condition the network like appearance with the involved granules is very striking and puts the question of artefacts out of the question. The experimental evidence is also convincing which I have quoted.

The striking pallor of those affected with lead-poisoning has for a long time been observed, yet the most thorough examination of the blood and careful examination of the Erythrocytes, the estimation of the Haemoglobin, exhibit very little abnormality. Sometimes in the blood count the red cells are above the normal and the Haemoglobin little reduced. The colour index of four of my cases was above the recognised standard. Grawitz (2) was of the opinion that the anaemia of lead-impregnated cases was only apparent, the deception being brought about through the influence of lead upon the muscular walls of the superficial blood vessels which are in a state of contraction.

After his researches and experiments he discarded this view believing that the large number of granules in the red cells was sufficient to account

for the anaemia, and that the lead toxemia exercised a direct deleterious influence upon the blood cells thus acting as a true anaemia producer. Following this the vessels of the skin are poorly supplied thus producing the sign of pallor and anaemia.

On the examination of the blood of a number of file cutters in Sheffield, granules were found in almost every case although there were no other symptoms to point to lead poisoning than a certain amount of pallor.

Thus a careful examination of the blood is of real use in doubtful or obscure cases of anaemia especially as there exist such a number of possibilities of contracting lead poisoning in manufactures, trades, water supply, and now, to add to these numerous sources, that of taking patent drugs, etc., as abortifacients.

It is true that the existence of these granules can but be looked upon only as a symptom, but when taken together with other symptoms, it is of great value.

In the normal blood this granulation of the Erythrocytes has been noticed so that too much importance must not be put on the finding of a few affected cells in a blood spread. However, diagnosis can be aided in doubtful cases of Saturnism which are difficult to recognize, especially in the early stages of the disease, even before other morphological

changes can be recognized.

The cachexia or pallor of plumbism follows the production of these granules and its intensity is in almost direct proportion to the number of Erythrocytes affected.

An examination of the normal red cell may help in the elucidation of this question.

Professor E. H. Starling (7) in his description of the red corpuscle, says that "Each consists of a framework or stroma composed chiefly of proteid material, containing in its meshes, or in a state of loose chemical combination with it a red coloring matter; Haemoglobin, to which is due the color of the corpuscles and of the blood itself. By treating the blood with solutions of tannic or boracic acid, a separation occurs between the Haemoglobin and the stroma. The haemoglobin appears as a small ball near the centres of a colorless blood-disc, or it may be extended and lie just outside the stroma. If the plasma be diluted, water diffuses from the surrounding medium into the corpuscle, which swells up and becomes spherical."

The most satisfactory way of studying basophile granulations and the effects of lead toxemia on the erythrocytes is to make a fresh blood stain by Vaughan's method, using polychrome methylene blue, under the one-twelth oil immersion lens. The

erythrocytes appear in many preparations swollen and spherical under the influence of the fluid medium in which they are floating. Professor Starling in the above quotation states that the Haemoglobin, a proteid like substance, is diffused evenly and normally through the stroma of the red cells but when acted upon by certain acids it appears as a small ball near the centre of the colorless blood-discs.

By analogy, when the lead toxin circulates freely in the blood stream, it acts upon the erythrocytes, bringing about a degenerative change in the haemoglobin, heaping it up and clumping it into small masses of granules which reacts to a basic dye in its abnormal condition. It becomes entangled in the stroma and so gives the characteristic appearance seen in the above made preparations. A delicate network with the dot-like granulations arranged along the threads. These vary in their distribution and arrangement in the stroma in a haphazard fashion, possibly controlled more or less by the constitution of the individual cell, its powers of resistance to the poison, resistance of the capsule and amount of haemoglobin it contains.

White and Pepper noted a similar appearance in the erythrocytes and a clumping of the granules in certain of their experimental cases on dogs. As far as I can learn they did not use the above method

for the examination of human blood. Cadwalader believed this variety of granulation to be a stage in the dissolution of the erythroblasts; but that can scarcely be possible as it is only by this method that clumping is observed. The 3 abnormal conditions, disintegrating erythroblasts, fine granular erythrocytes and the above clumping in a suggested network, do not exist together in any one method of staining.

The fine granules found in the dried smear preparations I believe are the same as the clumping granules in the wet preparation. But that in the process of preparing them the granules become detached from the stroma and distributed through the red cell. This holds equally good in the case of the erythroblasts. Their haemoglobin is affected by the circulating poison. The dissolution of the nuclei is a separate and distinct process.

An explanation for the pallor in lead-poisoning may here be presented and the appearance accounted for. The chemical constitution of the Haemoglobin has been altered. Its even distribution throughout the stroma destroyed in a definite percentage of red cells, which vary according to the intensity of the poison, so the skin is deprived of its color. The greater the number of Erythrocytes affected, the more marked the pallor. As the patient ad-

vances towards convalescence and as the poison is eliminated steadily from the blood stream,- the red cells are regaining their normal condition and the color of the patient improving. In several of the cases there was deficitnt staining power of the erythrocytes, presenting an anaemic appearance of the cell, probably due to the deleterious influence of the poison in the cell. The breathlessness that some of the cases complained of was doubtless due to the loss of function of the haemoglobin, deprived of its power of carrying oxygen to the tissues and assisting in the excretion of carbon di-oxide. It is impossible to say how many of the symptoms of lead poisoning might be due directly to this loss of function of the erythrocytes, and which rapidly progress as the patient becomes impregnated with lead synchronous with the rapid increase of granular red cells.

CONCLUSIONS

1. Basophilic granular erythrocytes are always found in the blood of patients suffering from lead poisoning and may be accompanied by nucleated red corpuscles.

2. That these granules are a true degeneration of the haemoglobin in the red cells and are in no way related to the disintegration of the nucleus of the erythroblasts.

3. That the origin of the basophilic granular red cells is in the general circulation and due directly to lead toxemia.

4. That the granular red cells never show any evidence of nuclear fragmentation or origin.

5. That the granules disappear in cases of lead poisoning as convalescence is established and that their number in the blood stream is an indication of the severity of the intoxication.

6. That the anaemia secondary to lead poisoning, is generally only of a moderate degree and that the pallor of the skin is due to degeneration and clumping of the haemoglobin in the red cells.

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